Western European Journal of Medicine and Medical Science
Volume 3, Issue 12 December 2025
https://westerneuropeanstudies.com/index.php/3
ISSN (E): 2942-1918 Open Access| Peer Reviewed

THOROUGH FORENSIC MEDICAL ANALYSIS OF EYE INJURIES IN LIVING INDIVIDUALS.

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Annotation. The article is devoted to a comprehensive forensic medical characterization of ocular injuries in living individuals. Modern approaches to the classification of ophthalmic trauma are examined, including etiological, mechanical, and anatomical-topographical criteria that allow for a more precise determination of injury patterns and their pathogenetic features. The mechanisms of formation of various types of injuries—from blunt and penetrating to combined and blast-related—are analyzed in detail, which is essential for reconstructing the circumstances of injury and for accurate expert interpretation.Particular attention is given to the diagnostic capabilities of contemporary imaging technologies, such as optical coherence tomography, ocular ultrasonography, and orbital computed tomography. These methods provide high accuracy in detecting subtle, minimally expressed, and deep structural alterations that remain inaccessible during traditional clinical examination. Criteria for determining the degree of harm to health are presented, based on a comprehensive assessment of functional impairment, long-term consequences, and the risk of irreversible loss of visual functions. The pivotal role of commissioned (panel) forensic medical examinations in complex, controversial, iatrogenic, and conflict situations—where multidisciplinary analysis is required—is emphasized.The findings contribute to the improvement of expert assessment algorithms and promote the unification of approaches to evaluating ocular trauma in contemporary forensic medical practice.
Key words: forensic medicine; ocular trauma; eye injury; organ of vision; injury mechanism; severity assessment; imaging; OCT; orbital CT; examination.

СУДЕБНО-МЕДИЦИНСКИЙ АНАЛИЗ ТРАВМ ОРГАНА ЗРЕНИЯ У ЖИВЫХ ЛИЦ.

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Аннотация. Статья посвящена комплексной судебно-медицинской характеристике травм органа зрения у живых лиц. Рассматриваются современные подходы к классификации офтальмотравм, включающие этиологические, механические и анатомо-топографические критерии, позволяющие более точно определять характер повреждений и их патогенетические особенности. Подробно анализируются механизмы формирования различных видов травм — от тупой и проникающей до сочетанной и взрывной, что имеет важное значение для реконструкции обстоятельств

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повреждения и экспертной интерпретации. Особое внимание уделено диагностическим возможностям современных визуализирующих технологий, таких как оптическая когерентная томография, ультразвуковое сканирование глазного яблока и компьютерная томография орбит. Эти методы обеспечивают высокую точность выявления скрытых, минимально выраженных и глубинных структурных изменений, недоступных традиционному клиническому осмотру. Представлены критерии определения степени тяжести вреда здоровью, основанные на комплексной оценке функциональных нарушений, стойких последствий и риска необратимой утраты зрительных функций. Подчеркивается ключевая роль комиссионной судебно-медицинской экспертизы в спорных, сложных, ятрогенных и конфликтных ситуациях, где требуется междисциплинарный анализ. Полученные данные позволяют совершенствовать алгоритмы экспертного исследования и способствуют унификации подходов к оценке офтальмотравм в современной судебно-медицинской практике.
Ключевые слова: судебная медицина; офтальмотравма; травма глаза; орган зрения; механизм травмы; степень тяжести; визуализация; ОКТ; КТ орбит; экспертиза.

ТИРИК ШАХСЛАРДА КЎРИШ ОРГАНИ ШИКАСТЛАНИШЛАРИНИНГ КОМПЛЕКС СУД-ТИББИЙ ТАВСИФИ.

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Аннотация. Мақола тирик шахсларда кўриш органи жароҳатларининг комплекс суд-тиббий тавсифига бағишланган. Офтальмотр травмаларнинг замонавий таснифига оид ёндашувлар – этиологик, механик ва анатомо-топографик мезонлар – кўриб чиқилади ва улар жароҳатларнинг хусусияти ҳамда патогенетик хусусиятларини аниқроқ белгилаш имконини беради. Турли хил жароҳатларнинг шаклланиш механизмлари – биттаги ва ўткир, қўшма ҳамда портлаш билан боғлиқ жароҳатлар – батафсил таҳлил қилинади. Бу жараён жароҳат юз берган ҳолатларни қайта тиклаш ва уларни тўғри экспертлик талқини учун муҳим аҳамиятга эга.Замонавий визуализация технологияларининг диагностик имкониятларига алоҳида эътибор қаратилган. Жумладан, оптик когерент томография, кўз олмасининг ультратовушли текшируви ва орбитал компьютер томографияси каби усуллар анъанавий клиник кўрикда кўринмайдиган яширин, минимал даражада намоён бўлувчи ёки чуқур жойлашган тузилмавий ўзгаришларни юқори аниқлик билан аниқлаш имконини беради. Соғлиққа етказилган зарарнинг оғирлик даражасини баҳолаш мезонлари тақдим этилган бўлиб, улар функционал бузилишлар, барқарор оқибатлар ва қайтарилмас кўриш йўқолиши хавфини комплекс баҳолашга асосланади. Шубҳали, мураккаб, ятроген ва низоли ҳолатларда мултидисциплинар ёндашувни талаб этувчи комиссиявий суд-тиббий экспертизани аҳамияти алоҳида таъкидланган.

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Калит сўзлар: суд-тиббиёт; офтальмотр травма; кўз жароҳати; кўриш органи; жароҳат механизми; зарар даражаси; визуализация; ОКТ; орбита КТ; экспертиза.

Введение. Eye injuries in living individuals represent one of the most complex categories of forensic medical damage due to the high functional significance of the eye, its vulnerability, and the considerable variability of clinical manifestations [1,3]. According to epidemiological studies, ocular trauma accounts for up to 10–15% of cases of temporary or permanent loss of visual function, which determines its high social and forensic relevance [1,4].

For a forensic medical expert, accurate determination of the mechanism of injury, the anatomical and topographical characteristics of the damage, and their functional consequences is of particular importance, as these parameters form the basis for assessing the severity of harm to health [10,13]. Modern international guidelines emphasize the need for a comprehensive approach that includes the analysis of objective clinical data, correlation with the circumstances of the incident, and the use of high-precision imaging techniques [11,12,15].

Imaging techniques such as optical coherence tomography, ocular ultrasonography, and computed tomography of the orbits significantly expand the diagnostic capabilities in the forensic medical analysis of ocular trauma, allowing the detection of both superficial and deep injuries that are not always evident during routine clinical examination [9,14].

Additional complexity is presented by iatrogenic injuries that arise as a result of diagnostic or therapeutic interventions. Their forensic evaluation requires correlating established standards of medical care, clinical documentation, and the potential risks associated with specific procedures [1,7,8]. In such cases, the importance of collegial (multidisciplinary) analysis increases, as confirmed by data from international forensic medical practice [8].

Thus, the need to unify approaches and to objectify the criteria for evaluating eye injuries determines the relevance of a comprehensive forensic medical examination of this issue.

The aim of the study- is to identify the types and characteristics of the formation of eye injuries.

Materials and Methods. A retrospective analysis of 56 forensic medical examination reports was conducted as the primary study material. These examinations were performed in the outpatient department of the Tashkent City Branch of the Republican Scientific and Practical Center of Forensic Medical Examination during the period 2021–2022. Medical records (case histories) were also analyzed, as all examined individuals had undergone inpatient treatment. Standard research methods were applied, including radiological, macroscopic, and statistical methods.

Results. According to the obtained data, eye injuries were identified in all examined cases. Among the affected individuals, there were 39 men (69.64%) aged 14 to 66 years and 17 women (30.36%) aged 20 to 50 years. Combined eye injuries accounted for approximately 66.67% of all ocular trauma cases. Based on victims' statements and case circumstances, eye injuries most frequently occurred during physical altercations and in domestic settings. The following types of ocular injuries were identified: penetrating injuries (18.67%) and blunt injuries (80.33%); eyelid and orbital injuries (72.78%) and conjunctival and scleral injuries (27.22%); single injuries (78.22%), double injuries (14.44%), and multiple injuries (7.33%); unilateral (75.56%) and bilateral (24.44%); eye contusions (87.11%) and orbital wall fractures (12.89%); fractures with displacement of bone fragments (24.22%) and without displacement (75.78%); direct injuries (85.89%) and indirect injuries (14.11%).

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During the analysis of the materials submitted for forensic examination, it was established that in many cases the injuries corresponded to mild severity. In ocular trauma, violations of the integrity of the tissues of both the anterior and posterior segments of the eye were observed, as well as damage to the surrounding soft tissues of the orbital region.

Penetrating injuries were characterized by defects of the cornea or sclera with loss of globe integrity and a risk of prolapse of intraocular structures. Incomplete injuries (partial lacerations, micro-fissures) were manifested by the preservation of the integrity of individual layers of the cornea or sclera, accompanied by localized edema and hemorrhage.

The most typical injury zones included the cornea, limbal region, anterior chamber, iris, lens, as well as the peri- and intrabulbar areas. Traumatic lesions of the posterior segment involved retinal tears, vitreous hemorrhages, and optic nerve damage [1,6,7]. Injuries to the eyeball were generally accompanied by changes in the soft tissues of the periorbital region—abrasions, eyelid contusions, hematomas, wound defects, edema, and hemorrhages of varying severity.

In some cases, pronounced swelling of the eyelids and periorbital tissues significantly complicated the diagnosis of ocular injuries. In several cases, palpation of the orbital rim revealed tenderness, a “step-off” sign, and localized crepitus, which are characteristic of orbital wall fractures. An indirect load symptom was also detected, manifested by pain upon pressure applied to the opposite orbital margin.

During examination of the conjunctiva and the surface of the eyeball, conjunctival lacerations, hemorrhages of various localizations, deformation of the globe contours, and displacement or recession of the eyeball were identified in cases involving orbital wall damage.

Radiography of the orbits in frontal and lateral projections revealed disruptions in the integrity of the orbital bone structures. It should be noted that fractures of the medial or inferior orbital wall were more frequently diagnosed using more precise methods—computed tomography—which allowed visualization of displaced bone fragments and the presence of foreign bodies.

In cases of blunt-force impact to the orbital region, the mechanism of bone fragment displacement is typically associated with the force of the blow and the negative pressure generated within the orbit. Thus, in unilateral orbital fractures, the eyeball may shift downward and posteriorly, accompanied by diplopia and restricted ocular mobility due to entrapment of the extraocular muscles [2,5,6].

In cases of bilateral injuries, as well as in severe disruptions of the inferior orbital wall, enophthalmos (posterior displacement of the eyeball) may develop. This condition is accompanied by significant impairment of visual function and the development of potentially life-threatening complications, including optic nerve compression, compromised ocular blood supply, and the risk of irreversible vision loss.

Conclusion. Eye injuries have high forensic medical significance, as they often lead to persistent functional impairments and require precise determination of the mechanism of injury. A comprehensive approach to the diagnosis of ocular trauma is essential and must include clinical examination, imaging techniques (OCT, ocular ultrasonography, orbital CT), assessment of visual functions, and analysis of the circumstances of the injury.

The classification of ocular trauma should take into account the mechanism of impact, the anatomical and topographical level of damage, the severity of injury, and the potential prognosis, which ensures objectivity in forensic medical evaluation. Modern imaging methods

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significantly improve diagnostic accuracy by revealing hidden or subtle injuries to the ocular and orbital structures that may not be detectable during routine examination.

Injuries to the eyeball and orbit are often accompanied by damage to the soft tissues, which requires mandatory documentation and correlation of morphological features with the presumed mechanism of impact. The determination of the degree of harm to health must be based on quantitative criteria of functional impairment, including reduced visual acuity, limitation of ocular movements, and signs of permanent loss of visual functions.

In complex, disputed, and iatrogenic cases, a key role is played by the commissioned (multidisciplinary) forensic medical examination, which helps minimize diagnostic errors, resolve discrepancies in expert opinions, and increase the reliability of forensic conclusions.

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